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Probing local photocurrent in inorganic $CsPbBr_3$ perovskite films by scanning probe microscopy

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Hybrid organic-inorganic halide perovskites are among the most promising materials for solar cells. Rapid growth of their power conversion efficiency (PCE) from 3.8% in 2009 [1] to more than 22% in 2017 [2] made them attractive for commercial applications. However, rapid degradation of organic-inorganic perovskites under operating conditions – photon flux, electric field, heating – remains unsolved in spite of tremendous research effort [3,4]. Their fully inorganic counterparts possess similar optoelectronic properties [5] and better stability [6]. Still, their PCE is below 10%, which requires further investigation and optimization.

In this work we implemented conductive Scanning Probe Microscopy (c-SPM) to measure local photocurrent from the all-inorganic $CsPbBr_3$ layer deposited on a glass/ITO/PEDOT:PSS substrate. We observed enhanced photocurrent from the thermally aged sample as compared with the pristine one. Spatially-resolved photocurrent map revealed that grain boundaries on the aged sample possess higher electric conductivity than grain bulk, while such difference was not observed on the pristine sample. This effect was accompanied by the downward band bending along grain boundaries, suggesting splitting of photogenerated electron-hole pairs at grain boundaries by the built in electric field. The observed at the nanoscale current increase was confirmed by macroscopic measurements on the solar cells device with the planar junction ITO/PEDOT:PSS/$CsPbBr_3$/PCBM/Ag architecture.

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